



The Scottish Mathematical Council

www.scot-maths.co.uk

MATHEMATICAL CHALLENGE 2014–2015

Entries must be the unaided efforts of individual pupils.

Solutions must include explanations and answers without explanation will be given no credit.

Do not feel that you must hand in answers to all the questions.

CURRENT AND RECENT SPONSORS OF MATHEMATICAL CHALLENGE ARE

The Edinburgh Mathematical Society, The Maxwell Foundation, Professor L E Fraenkel,

The London Mathematical Society and The Scottish International Education Trust.

The Scottish Mathematical Council is indebted to the above for their generous support and gratefully acknowledges financial and other assistance from schools, universities and education authorities.

Particular thanks are due to the Universities of Aberdeen, Edinburgh, Glasgow, Heriot Watt, St Andrews, Stirling, Strathclyde and to Bearsden Academy, Beaconsfield School and Northfield Academy.

Senior Division: Problems 1

- S1.** Two ferry boats set out at the same time from opposite banks of a loch. One boat is faster than the other and they pass each other at a point 650 metres from the nearer bank. After arriving at their destinations, each boat remains for 15 minutes to change passengers and then sets out on the return journey. This time, they meet at a point 350 metres from the other bank. How wide was the loch?
- S2.** Given that $x^2 + \frac{1}{x^2} = 7$ and $x > 0$, find the exact value of $x^5 + \frac{1}{x^5}$ in its simplest form.
- S3.** The lengths of the diagonals of a rhombus are 6 and 8. An equilateral triangle inscribed in this rhombus has one vertex at an end-point of the shorter diagonal and one side parallel to the longer diagonal. Determine the length of a side of this triangle.
Express your answer in the form $k(4\sqrt{3} - 3)$ where k is a vulgar fraction.
- S4.** In the following multiplication, each letter represents a different digit between 1 and 9.

$$\begin{array}{r} \times \quad \begin{array}{ccc} A & B & C \\ & D & E \\ \hline F & E & C \\ D & E & C \\ \hline H & G & B & C \end{array} \end{array}$$

What two numbers are being multiplied together?

- S5.** A *multiply-perfect number* is one for which the sum of its distinct factors, including 1 and the number itself, is an integer multiple of the given number. Show that 30240 is a multiply-perfect number.

END OF PROBLEM SET 1

CLOSING DATE FOR RECEIPT OF SOLUTIONS :

26th September 2014

Look out for Problems 2 in early December!

Look on the SMC web site: www.scot-maths.co.uk for information about Mathematical Challenge



Mathematical Challenge Problems 1

SENIOR DIVISION 2014–2015

PLEASE USE CAPITALS TO COMPLETE

SURNAME

OTHER NAME(S)
(underline the one
you prefer)

SCHOOL

AGE

YEAR OF STUDY

S

FOR OFFICIAL USE

Marker

Marks

1	2	3	4	5

Total

— — — — - **CUT ALONG HERE** — — — —

Please write your solutions on A4 paper and staple the above form to them.

PLEASE WRITE YOUR NAME ON EVERY PAGE.

Send your entry through your school to :

Tadahiro Oh

School of Mathematics, The University of Edinburgh
James Clerk Maxwell Building, The King's Buildings,
Mayfield Road, Edinburgh EH9 3JZ

For further information on the competition, please see the Information Circular, which has been distributed to all secondary schools. Please contact the local organiser, whose name and address are given above, if you require a further copy.
